Space Weather Technical Forecast

Issued on Wednesday, 30 August 2023 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of isolated M-class flares (R1-R2 Blackouts). Glancing CME arrival possible Day 1 (30 Aug) with a slight chance of G1/Minor Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Low with mostly minor C-class flares in the past 24 hours. There are five numbered sunspot regions on the visible disc. Two of these are small and simple. Of the three main sunspot groups, AR3415, in the southwest, is the most complex, with a delta spot configuration, but remains largely inactive. AR3413 in the northwest, has changed little. AR3417 in the southeast remains classified as Dso/Beta-Gamma configuration and was the origin of the largest flare, reaching C3.9 flare at 29/2327 UTC. This region may show more complexity as it continues to rotate onto the disc. A new unnumbered region in the northeast appears simple as Hsx/Alpha.
No new Earth directed CMEs have been seen in available imagery over the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE/DSCOVR at L1, have been at slow-ambient levels around 350km/s. Density was mostly average with a decreasing trend to slightly below average levels. The interplanetary magnetic field, Bt, was mostly weak around 8nT, with an erratic drift to lower levels. The north-south component, Bz, started the period positive (Northward directed) before a change from 29/0830UTC to negative (southward directed) for a few hours. The Phi angle was predominantly negative (towards the Sun) and the above parameters are probably evident of a weak connection to CH38/- (no longer on disc) and HSS, although with some uncertainty. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at background levels. GOES16 high energy (greater than 2MeV) electron flux was at background to moderate levels. The associated 24-hour fluence was well below Active on an initially steady then downward trend, with 2.81e6 integrated pfu observed at 29/2100 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: The current Low solar activity is expected to continue with a chance of an isolated M-class flare. The most likely source for this activity probably from AR3417 located in the southeast that produced the last moderate flare.

Solar Wind / Geomagnetic Activity: A CME may give a glancing impact at Earth sometime on Day 1 (30 Aug), though this is low confidence. There are no other Earth-directed CMEs currently forecast. Solar winds are at slow-ambient levels and will probably remain unchanged until the potential CME arrival mentioned above. The next impact on the solar winds looks to be coronal hole (CH40/+) which may give an enhancement to slightly elevated levels, 450-500km/s, into Day 3 (01 Sep). Geomagnetic activity is expected to remain generally Quiet. If the CME glance occurs on Day 1 (30 Aug), activity may become Unsettled to Active with a slight chance of

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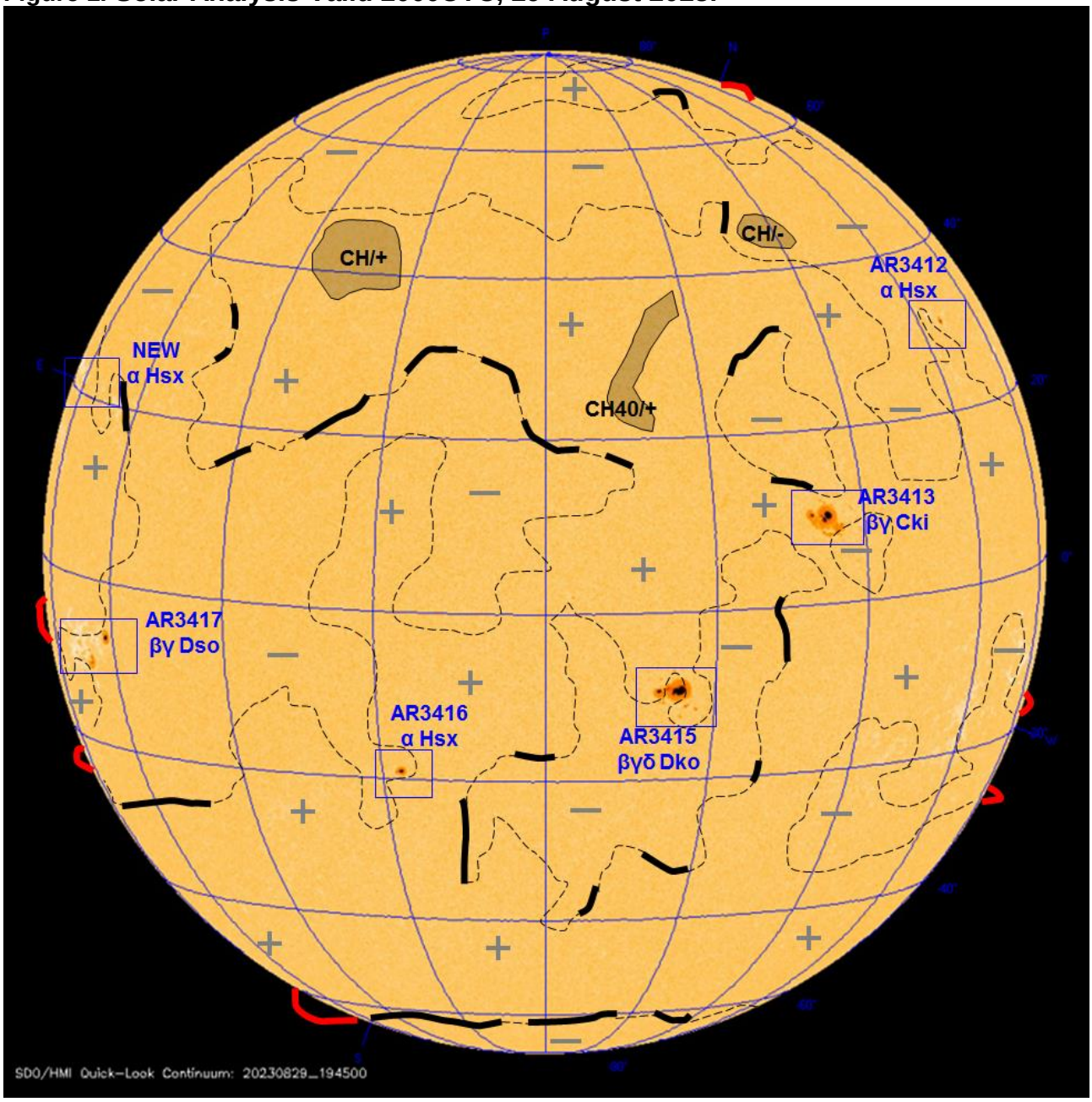
G1/Minor Storm intervals, with any effects easing into Day 2 (31 Aug) before potential coronal hole influence likely increases activity once again into Day 3 (01 Sep).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at background levels, with just a slight chance of enhancement, mainly should any larger flares occur from AR3413 or AR3415. High energy (greater than 2 MeV) electron flux is expected to persist at background to moderate levels. The associated 24 hour fluence is expected to remain below the Active level (1e8 integrated pfu) on a probable flat trend, and may even drift lower in coming days.

Figure 1. Solar Analysis Valid 2000UTC, 29 August 2023.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

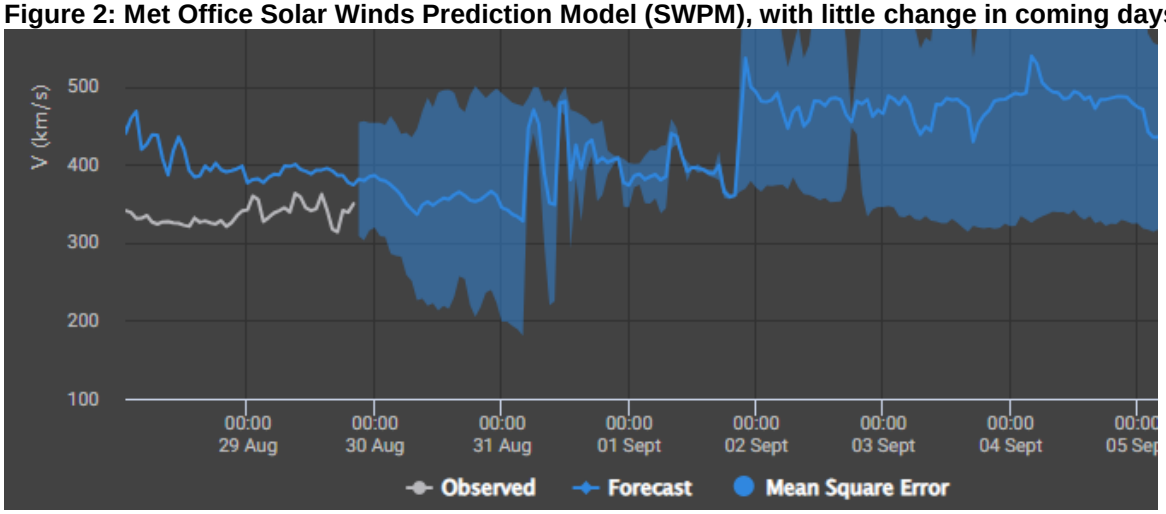
The C2.2 flare and associated dimming from AR3413 at 25/1006 UTC generated a CME, with a very faint eruption subsequently detected in SOHO imagery. Assessment of this gives a probable glancing CME impact at Earth sometime on Day 1 (30 Aug) though this is low confidence. There are no other Earth-directed CMEs currently forecast. Solar winds are slow-ambient, with limited enhancement recently seen from the forecast CH38/-, and are expected at similar levels until the aforementioned, potential CME arrival in coming hours The next enhancement on solar winds looks to be a coronal hole enhancement from two northern hemisphere coronal holes, with a particular focus on recurrent CH40/+ near centre disk. The Met Office Enlil guidance indicates solar winds reaching slightly elevated levels, 450-500km/s, into Day 3 (01 Sep). Geomagnetic activity is expected to remain generally Quiet. If the CME glance occurs on Day 1 (30 Aug), activity may become Unsettled to Active with a slight chance of G1/Minor Storm intervals, with any effects easing into Day 2 (31 Aug) before potential coronal hole influence likely increases activity once again into Day 3 (01 Sep).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	5	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Solar Winds Prediction Model (SWPM), with little change in coming days.



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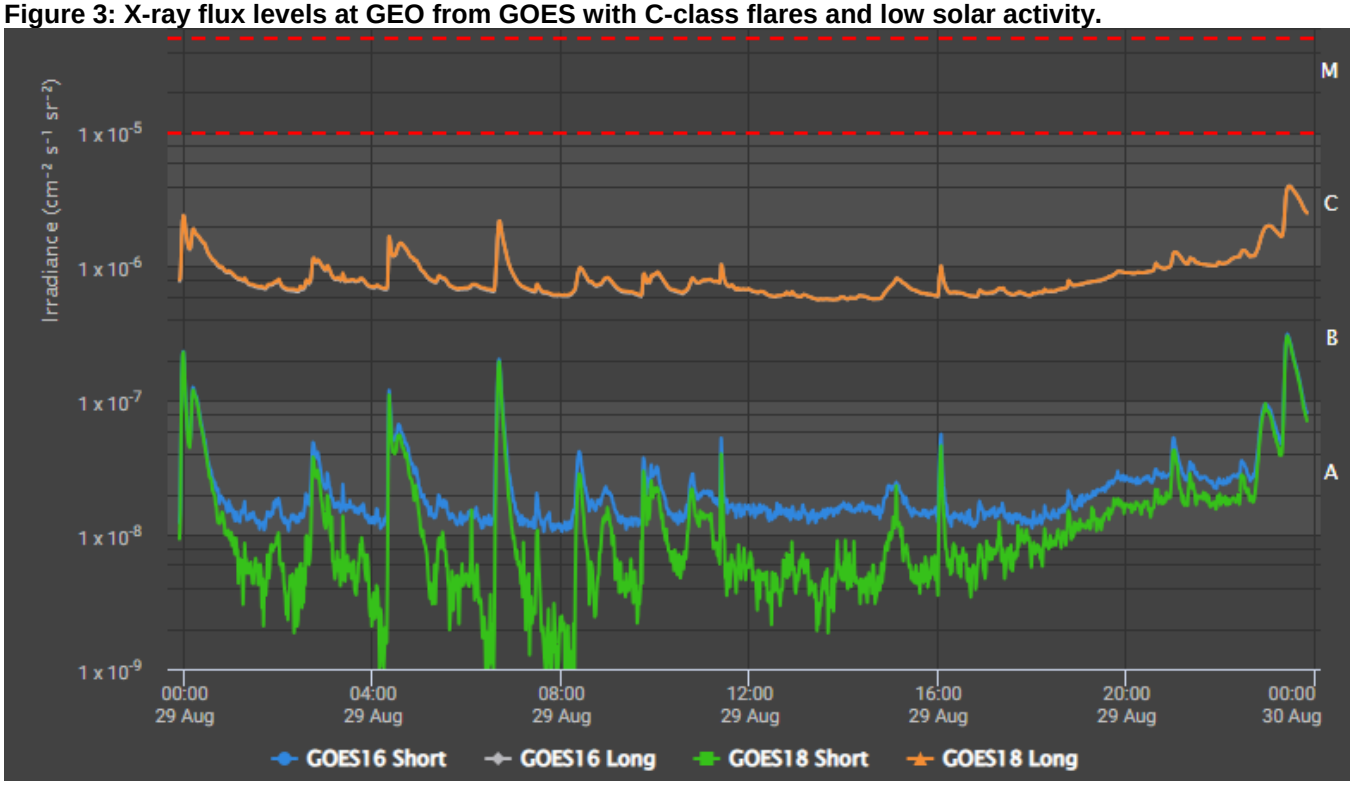
Radio Blackouts - X-Ray Flares:
The current low solar activity is expected to continue during the forecast period, but there is a slight chance of further isolated M-class flares, either from AR3413/AR3415 or perhaps more likely from AR3417 in the southeast given this spots history of recent M-class flare activity. There are five numbered sunspot regions on the visible disc. Two of these are small and simple with limited flare risk expected. There are three sunspot groups of interest providing the bulk of flare risk. AR3415 (Dkc/Beta-Gamma-Delta) in the southeast continues with a delta spot configuration, but has remained largely inactive with activity lower than the classification would suggest. The larger AR3413 (Cki/Beta-Gamma) in the northwest has shown some development cycles in the leading spots and has a history of a north-south magnetic alignment and some low level flaring. AR3417a region in the southeast gave a long period M-class flare on 26 Aug from over the eastern limb, so this region is one to watch, with a slightly enhanced potential for further flaring. All three features remain on the visible disk through the coming days with no significant oncoming regions expected.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray flux levels at GEO from GOES with C-class flares and low solar activity.



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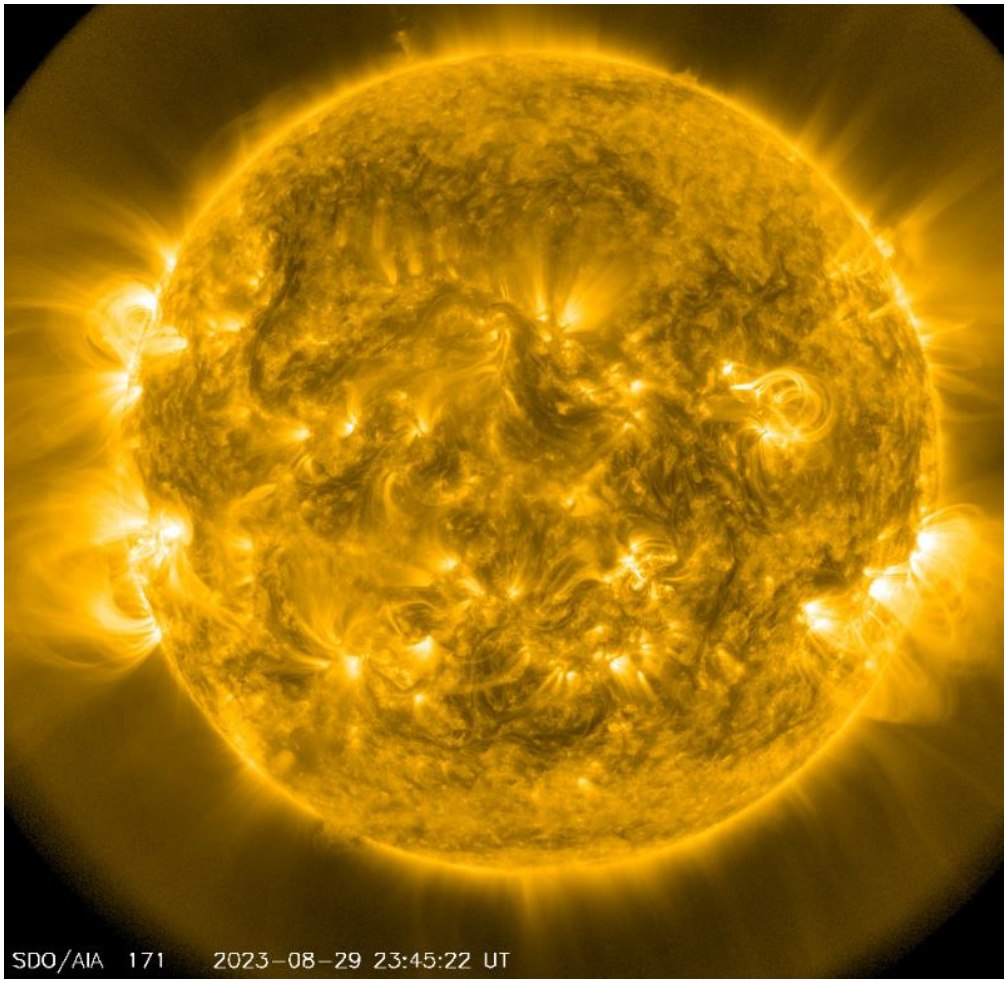
Solar Radiation Storms - (High Energy Protons):
High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at background levels with just a slight chance of enhancement. The main risk of any increased proton flux would be from the occurrence of any larger flares from AR3415 or AR3413.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO/AIA 171 imagery shows magnetic looping associated with AR3417 in the east.



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High Energy Electrons Event (≥ 2MeV):
High energy (greater than 2 MeV) electron flux observed by GOES16 is expected to remain at background to moderate levels for much of the period, given a lack of recent electron enhancement. A possible CME glancing blow on Day 1 (30 Aug) and any associated geomagnetic activity should also act to keep flux levels suppressed.
The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) level, with any rise in fluence likely to be modest. This is supported by Met Office REFM guidance, which currently appears to offer sensible advice.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	5	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: High energy elctron flux at GEO and MOSWOC REFM electron fluence, observations and recurrence data.

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